

suggests might be used as an indicator. He repudiates determination of the dioxide in leaves as a test, and does not favour that of sulphuric acid; but he thinks that evaluation of the concentration of the gas in the air would be of some importance in determining the extent of its deleterious influence, the minimal lethal content being apparently somewhere near 1:500,000. Injection of the intercellular spaces of leaves is a certain sign of injurious action of the gas, but not a specific one; this is also an induced effect.

Limitation of space forbids more than the shortest critique of this monograph. Its literary style and practical value would have been greatly enhanced had the author written it in a shorter manner; the wording is diffuse, and there is too much recapitulation. Prof. Wieler has, moreover, an unfortunate habit of interpolating the results of his experiments in the text, which consequently resembles a note-book in these parts; one result of this is intolerable weariness in the reader. The modes of application of many of the methods are susceptible of improvement, and conclusions are not infrequently drawn from results that are too ambiguous for the purpose.

But it is easy for a reviewer to be captious or hypercritical. The problems that Prof. Wieler has endeavoured to solve certainly involve considerable practical difficulties, and necessitate expenditure of much time and labour. His rehabilitation of an old hypothesis is ably done, and it is probable that subsequent work may confirm his results and conclusions, and raise the hypothesis to the rank of a theory.

F. ESCOMBE.

SOME SIDE ASPECTS OF MATHEMATICS.

L'Algèbre de la Logique. By Louis Couturat. *Scientia*, No. 24. Pp. 100. (Paris: Gauthier-Villars, 1905.)

A Geometrical Political Economy. By H. Cunynghame, C.B. Pp. 128. (Oxford: Clarendon Press, 1904.) Price 2s. 6d. net.

THERE are very few branches of study which cannot be made the subject of exact reasoning, and such reasoning can almost always be made, if not more exact, at least more simple and precise in its mode of expression by the adoption of mathematical language and the application of mathematical methods.

M. Couturat's work affords a general *exposé* of the symbolical analysis of logic founded by George Boole (1815-1864), and developed and perfected by Ernst Schröder (1841-1902) and other writers. It is an interesting study, not only to the logician, but also to the mathematician, who here is brought into contact with an algebra differing completely in its laws from the various algebras invented in connection with the study of directed and undirected magnitudes. Its symbols, in fact, do not denote magnitudes, but concepts or propositions. Its signs are based on those of algebra with the exception of the accent denoting negation, but the operations follow laws of their own. The discussion of these laws given in the present book is based on the works, not only of Boole and

Schröder, but also of Venn, Stanley Jevons, Poretsky, Macfarlane, Whitehead, Müller, Johnson, and Huntington. While the treatment appears suitable to a beginner, it must not be forgotten that in commencing the study of *any* algebra great difficulty is in general experienced in forming a tangible conception of the symbols involved. This criticism applies quite as much to ordinary algebra as to the subject-matter of the present work. Among all the algebras for beginners that have been written, we have not yet come across one which does exactly what is wanted, viz. base the subject on the *use of formulae* in numerical calculations relating to concrete quantities. On the other hand, readers of the present book are usually of maturer years, and may be better able to supply the illustrations for themselves.

In logic we have to deal with a discrete series of concepts or propositions, and it is natural that the language of algebra should be well suited to their treatment. The second book under review deals with quantities which are capable of continuous variations not necessarily expressible by any exact law, and for the study of these graphical methods are the most suited. Mr. Cunynghame's book does not require any knowledge of mathematics except such geometry as has been acquired at school, and very little of that. When we add that this particular knowledge mainly consists in the capacity to represent on squared paper the fluctuations in the price of wheat, the national debt, or the income tax, and that special stress is laid on this capacity in modern school examinations, it will be seen that the present is a very favourable time for introducing a book of the kind. We may not live to see the time when electioneering addresses take the form of mathematical lectures illustrated by diagrams, but we may be certain that, if any nation ever rises to this state of intelligence—and at the present time Germany is the most promising—that nation will outstrip all others in efficiency and prosperity. It is only by methods such as those here described that fiscal questions can be studied, and it is much to be hoped that the present book will teach a few English people how misleading it is to rush to conclusions based on *isolated* statistics, which can be turned about in such a way as to prove anything.

The method of this book was introduced into England by Prof. Marshall, Fleming Jenkin, and Stanley Jevons, and the author is also indebted to Prof. Foxwell for much information. The subjects treated include supply and demand, surplus value, taxation, monopoly, international trade, and Marshall's curves.

Mathematical teachers may well reflect on Mr. Cunynghame's reason for avoiding the words "graph" or "graphical." According to his interpretation, a "graph" is to be regarded as "a curve which merely aims at presenting a collection of facts to the eye without any known law behind it. . . ." "When, however, a law can be discovered governing the form of the graph it ceases to be a mere graph and becomes promoted to the dignity of a curve." And yet "graphs" were introduced into elementary mathematical syllabuses with a great flourish of trumpets not so very long ago, and were

regarded by many people as something quite *chic* and up to date!

In conclusion, Mr. Cunynghame may claim to have presented us with a very clear and well expounded introduction to the important subject of which his book treats.

G. H. B.

TWO EGG-BOOKS.

(1) *Ootheca Wolleyana: an Illustrated Catalogue of the Collection of Birds' Eggs formed by the late John Wolley*. Edited by Alfred Newton. Part iii., Columbæ to Alcæ. (London: R. H. Porter, 1905.) Price 2l. 2s.

(2) *Eggs of the Native Birds of Britain and List of British Birds, Past and Present*. By W. J. Gordon. Pp. 64; 398 illustrations. (London: Simpkin, Marshall and Co., Ltd., 1905.) Price 3s. 6d.

IN the first of these two books Prof. Newton makes good progress with the catalogue of the unrivalled collection of eggs to which it is devoted, dealing in this instance with the pigeons, game-birds, rails, cranes, bustards, waders, gulls, and auks. Needless to say, it is written in the same style as its two predecessors, consisting almost entirely of Mr. Wolley's original notes, with such comments as the editor considered it advisable to intercalate here and there. To review the fasciculus is impossible within the limits of our space, and we can only refer to a few points of special interest. One of these relates to the eggs of the knot, of which a presumed specimen, laid in confinement, was given to the author by Lord Lilford; the correctness of this identification has been recently confirmed by the discovery of "wild" specimens. Equally interesting is the record of the first known egg of the stint, obtained by Middendorf in Siberia in 1843. The culminating interest of this fasciculus is, however, concentrated on the superb series of eggs of the great auk possessed by Mr. Wolley, which included no less than seven actual specimens, together with several casts. The first of the originals the author bought in 1846 for twenty-eight shillings; it may, perhaps, be now worth ten times as many pounds! Coloured figures (two of each) of the seven auks' eggs and of one of the casts form the illustrations to this fasciculus; and in the execution of these plates Mr. H. Grönvold has surpassed himself, having succeeded not only in showing the colouring and markings to perfection, but also in imitating to a nicety the very grain and texture of the shell. The eight specimens show very clearly the range of variation to which the colour and markings of the eggs of the species were subject.

Mr. Gordon's little book, which is, of course, a work of quite a different class from the last, is a well-intended attempt to place before the public, at a very low price, a satisfactory means of identifying the eggs of those birds which nest in the British Isles, or did so until within a comparatively recent period. That the author has taken great pains in grouping and photographing these eggs is perfectly evident, and if the colouring of the figures is in some instances not quite so true to nature as might be desired, this can

scarcely be considered his fault, while, if the low price at which the book is published be taken into consideration, it would be almost unfair to lay the blame on the lithographer. We cannot have perfection combined with cheapness in matters of this sort, and, considering its price, the book is a very creditable production.

In including extinct species of British birds in the list at the end of his work, Mr. Gordon has, we think, been ill-advised, as the majority of these are very imperfectly known, and they are not likely to interest the class of readers to whom this volume will appeal. Still, the inclusion is evidence of broad views on the part of the author. Both Prof. Newton and Mr. Gordon, we are glad to find, remain staunch conservatives in the matter of nomenclature, both as regards the use of generic terms in a wider and more comprehensive sense than is now, unfortunately, the fashion, and above all in eschewing the detestable "*Pica pica*" system. In both these respects, we venture to think, Mr. Gordon's work (the other does not, of course, appeal to the same class) will be far more acceptable to the general public than would have been the case had the author been induced to yield to the prevalent (and we trust fleeting) fashion

R. L.

OUR BOOK SHELF.

Engineering Chemistry: a Manual of Quantitative Chemical Analysis for the Use of Students, Chemists, and Engineers. By Thomas B. Stillman. Third edition. Pp. xxii+597. (Easton, Pa.: The Chemical Publishing Co.) Price 4.50 dollars.

At the present day chemical knowledge is so important a factor in the successful conduct of nearly all technical work that such books as Stillman's "*Engineering Chemistry*" appeal to a very large audience, and so well has the professor of analytical chemistry in the Stevens Institute done his work that the third edition will be as warmly welcomed as its predecessors. In it much of the work has been revised, the most modern standard methods introduced, and a considerable amount of new matter added, those portions on lubricating oils and the technology of the blast furnace being especially noticeable.

In so excellent a work criticism always seems ungracious, but there are a few points the author would do well to correct in the next edition. For instance, on p. 169 the author gives as a typical analysis of London coal gas

Hydrogen	...	...	...	...	...	27.70
Methane	...	...	...	...	...	50.00
Carbon monoxide	...	...	...	...	...	6.80
Ethylene	...	...	...	...	...	13.00
Nitrogen	...	...	...	...	...	0.40
Oxygen	...	...	...	...	...	0.00
Carbon dioxide	...	...	...	...	...	0.10
Aqueous vapour	...	...	...	...	...	2.00

100.00

and calculates that it would have a heating value of 870.15 B.T.U.'s gross.

Such an analysis is so absurdly wrong that it can only have been inserted by error, the main constituents more nearly approximating to hydrogen 50 per cent., methane 36 per cent., and ethylene 4 per cent.